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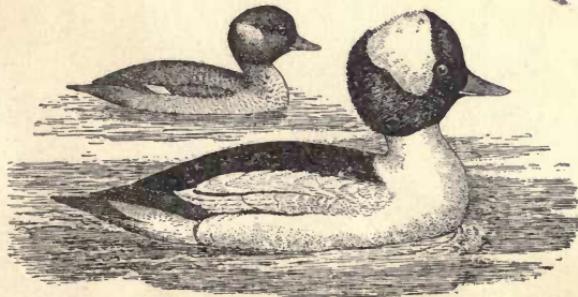


DEPARTMENT OF  
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## SOME UNDER-WATER ACTIVITIES OF CERTAIN WATERFOWL

By EDWARD HOWE FORBUSH  
Director, Division of Ornithology

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# A PRELIMINARY REPORT ON SOME UNDER-WATER ACTIVITIES OF CERTAIN WATERFOWL.

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EDWARD HOWE FORBUSH, DIRECTOR, DIVISION OF ORNITHOLOGY.

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## INTRODUCTION.

In preparing a work on Massachusetts birds it became necessary to settle some questions regarding the habits of birds in respect to which the statements of ornithologists do not agree. For example, ornithologists have gone on record with statements to the effect that the Coot, Brant, Gadwall or other waterfowl never dive; that grebes and certain other birds never use the wings for propulsion under water; that Wood Ducks and other arboreal nesting ducks do not carry the young from the nest to the water, etc. Such statements have been made by men whom ornithologists respect, but they should not have been made, as there is no possibility of proving them, and they are very likely to be misleading, to say the least.

He who says that a bird never does what it is possible for that bird to do is assuming too much knowledge for mortal man. We may well record what we have seen birds do, or report what any trustworthy observer has seen, but if we attempt to deny that a bird does this or that, or to base any theory on such an assumption, the burden of proof is on our heads, and sooner or later we may find ourselves in error.

Birds' habits vary according to circumstances and localities. Individual temperaments and behavior differ greatly. No description of the habits of a bird will do for all conditions and for all parts of its range. Some statements were made in my "History of the Game Birds, Wild-Fowl and Shore Birds" which have been adversely criticised. In nearly every case prior investigation or observation had convinced me that they were correct. It was learned afterward, however, that the behavior of certain ducks in the east was quite different from that of the same species in parts of the south and west,

while in other respects there was a great disparity in the habits of different individuals or of the same individuals under different circumstances.

During the past two years certain disputed habits have been investigated by sending out questionnaires over the United States and Canada. To meet the objection that no dependence can be placed on the observations of untrained persons, these questionnaires were sent mainly to accredited observers of the Division of Ornithology, and Fellows, Members and Associates of the American Ornithologists' Union. Evidence included in their replies is used largely in the report that follows. Among the subjects under inquiry were (1) the under-water progression of water birds, particularly that of loons, grebes, cormorants and the Water-Turkey; (2) the diving of the so-called surface-feeding ducks, geese and swans; (3) the so-called "suicide" of wounded ducks; and (4) the manner in which the young of tree-nesting ducks get to the water. A report on the first and third subjects is made in this bulletin. The fourth is treated in part in the annual report of the Division of Ornithology for 1921.

#### UNDER-WATER PROGRESSION OF GREBES.

While most ornithologists agree that many water birds such as auks, murres and certain ducks use their wings for progression under water, there is much disagreement regarding some other diving birds.

Many ornithologists have asserted positively that grebes, loons, cormorants and the Water-Turkey do not use their wings under water. As one advances in years, he learns by experience the folly of such negative assertions. The birds are not aware of our opinions or of the rules that we lay down for their behavior, and may refuse to be bound by our statements regarding how they should conduct themselves. Nevertheless, it is well to acknowledge at the outset that those who hold to the opinion that grebes never use their wings for under-water progression have some grounds for their belief. For example, Mr. Roy Latham of Orient, New York, informs me that he has seen "hundreds" of Horned Grebes in fish-traps where

the under-water movements of the birds could be watched, and that he never saw one use its wings for propulsion, or even raise them in under-water progression. Others have kept grebes in tanks or in shallow water and have never seen the birds use their wings at all. Mr. Walter B. Johnstone, Edgewood, British Columbia, Mr. A. S. Peters, Lake Wilson, Minnesota, and Mr. E. F. Pope, El Reno, Oklahoma, have had abundant opportunity to study grebes under water, and note that they never saw them make use of their wings in swimming. Mr. Harry S. Swarth, Berkeley, California, writes that he has watched the Western Grebe and the American Eared Grebe feeding under water. The Eared Grebe was not using its wings, and the Western Grebe apparently was not. Major Allan Brooks, Okanagan Landing, British Columbia, says grebes have been observed closely, and no sign of the wings being used or even opened under water has been seen. Dr. Arthur A. Allen, Ithaca, New York, has seen Horned Grebes and also Pied-billed Grebes under water propelled by feet alone. Mr. Harry A. Cash, Providence, Rhode Island, says that a captive Pied-billed Grebe that he kept in a tank did not use its wings for swimming. Dr. John B. May, Cohasset, Massachusetts, caught an injured Horned Grebe. It did not use its wings under water when swimming in a bathtub. Mr. Julian K. Potter, Camden, New Jersey, stood on a river bank some 10 or 15 feet high looking down at a Holboell's Grebe chasing minnows in shallow water. No motion of the wings was discernible. Mr. John Hooper Bowles, Tacoma, Washington, noted that Pied-billed Grebes under water used only their feet. Mr. Chester S. Day, Brookline, Massachusetts, who watched chicks of the Horned Grebe swimming and diving at the Magdalen Islands, says that they kept their wings close to the sides. My own experience corroborates these statements, as I have seen the Horned Grebe and the Pied-billed Grebe under water in tanks swimming with the wings held close to the sides.

At first glance, all this looks like conclusive evidence, but unfortunately for the negative belief others have noted the use of the wings in tanks, though rather rarely, and many have observed the wings in use for free swimming under natural conditions, either in the sea or in inland waters.

Audubon says that he kept two Pied-billed Grebes in a large tub, and that they swam like puffins, using their feet and wings "in accordance," and staying a long time under water.<sup>1</sup>

Reed writes as follows regarding the Pied-billed Grebe:—

In my boyhood I frequently cornered these birds in a creek or small cove, so that in order to escape it was necessary for them to swim under the boat. At these times we could plainly see their mode of progression. They flapped their wings in much the same way as in flying, and this in addition to their feet is what gives them their great speed. On one of these occasions, as the Grebe was going under the boat, my companion in his excitement leaped overboard, clothes and all. By some accident he happened to catch the bird by the neck.<sup>2</sup>

In American ornithological literature there is very little evidence of this habit among grebes, but fortunately unpublished observations are not lacking. Dr. A. K. Fisher, in charge of economic investigations in the Biological Survey, Washington, District of Columbia, says that he has seen grebes flying under water with the wings fairly well extended, but he does not mention the species. Mr. William L. Finley, Jennings Lodge, Oregon, says that in 1905 at Lower Klamath Lake he saw young Western Grebes swimming under water, using both feet and wings, the wings in quick strokes. Mr. Wright M. Pierce, Claremont, California, writes me that he saw an Eared Grebe swimming in the water under thin ice. The wings were half spread. He believed that the foot-strokes alternated with those of the wings. The bird moved faster when using both wings and feet. Mr. J. K. Jensen, Santa Fé, New Mexico, saw in February, 1918, an Eared Grebe swimming at Arroyo Hondo. The wings, he says, were about half spread and worked with quick strokes. The feet were used simultaneously with the wings. Both feet were used together. When the wings were raised, the feet were drawn up; and when the wings were brought close to the body, the feet struck out behind. Both wings and feet were employed all the time that he watched the bird. He sketched two swimming attitudes of the bird (see cut), showing the extreme positions of the wings and feet under

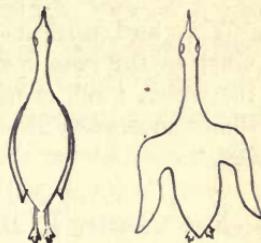
<sup>1</sup> Audubon, J. J.: *Ornithological Biography*, Vol. III, 1835, p. 361.

<sup>2</sup> Reed, Chester A.: *American Ornithology*, Vol. 1, No. 8, August, 1901, p. 149.

water. Mr. A. M. Brooking, Inland, Nebraska, says that he caught a wounded Eared Grebe. This bird was put in a tank in which in swimming under water it used its half-spread wings with short, quick strokes. The feet also were used. He believes that they alternated with the wings, but the wings were so rapidly used that he was not sure. The bird swam faster with both wings and feet than when using feet only.

Holboell's Grebe does not offer many opportunities to those who wish to watch its under-water activities on the Atlantic coast. As a rule, it is shy and keeps to wide waters, but on its breeding-grounds in the shallow sloughs of the prairies it has been seen to swim very rapidly under water by the use of its feet alone. In the winter of 1912 Mr. A. R. Cahn of Chicago had an almost unprecedented opportunity to watch the activities of this species under thin ice. Cayuga Lake in Western New York, a body of water 40 miles in length, was frozen over for the first time in years, and many Holboell's Grebes were trapped there by the ice. A single bird of this species was found alive in a small patch of open water in Fall Creek, below Ithaca Falls, surrounded on three sides by thin ice and on the fourth by ice strong enough to bear a man. The bird could not escape, as the water hole was too small for it to get headway enough on the surface to rise on the wing and it could not rise from the ice. Mr. Cahn stood on the ice by the open hole and watched the diving bird in the clear water below. The neck was extended to its full length and both wings and feet were used. The speed of the bird, he says, was marvelous, "at times it being almost impossible to follow its movements." Mr. Cahn writes me that the wings were about half open and were used with quick strokes.<sup>1</sup>

Mr. Frank Walters in a letter to Mr. H. H. Ballard of Pittsfield (printed in the "Berkshire Eagle," a Pittsfield newspaper) tells of a capture of Holboell's Grebe on March 4, 1912, in South Sandisfield, Massachusetts. The bird was in a little



First and second extreme positions of swimming grebe under water, when using both feet and wings. (Observed by J. K. Jensen.)

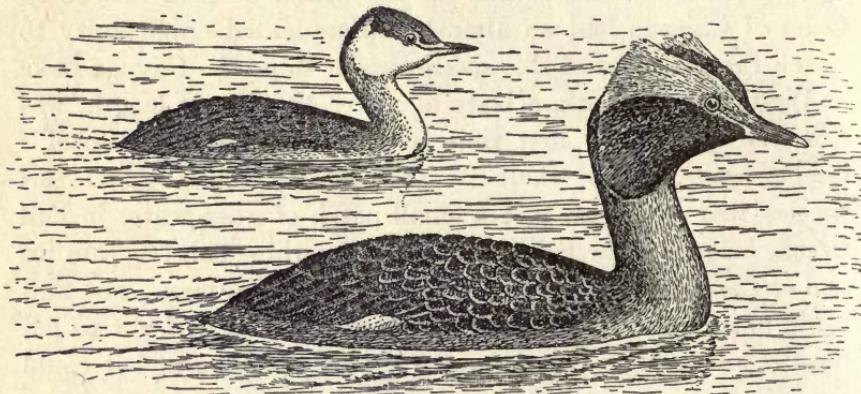
<sup>1</sup> Cahn, A. R.: Auk, Vol. XXIX, No. 4, October, 1912, p. 440.

brook. To escape, it swam in a small narrow strip of open water. Mr. Walters writes:—

This bird used its wings continually while swimming, using them much in the same manner as if in the air. . . . While the bird was in the water, I ran along the edge of the ice and had an excellent opportunity to observe this use of the wings, as the bird was almost at my feet.<sup>1</sup>

Mr. Charles L. Barnes, Bayonne, New Jersey, writes that in October, 1920, at Knops Pond, Groton, Massachusetts, a Holboell's Grebe dived and swam beneath his skiff. Although the flickering shadows lessened the accuracy of observation, it seemed that the bird used both feet and wings with great speed, in a manner similar to that of the Pied-billed Grebe.

My attention was first called to the use of the wings of grebes under water by Mr. Charles W. Vibert, South Windsor, Con-



Winter.

Summer.

HORNED GREBE (*Colymbus auritus*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

This species, like other grebes, uses both feet and wings at times for propulsion under water.

necticut, who wrote me about ten years ago that he had been keeping a Horned Grebe alive in a tank, and that it often raised its wings slightly when swimming under water. Late in November, 1917, Mr. C. A. Clark, Lynn, Massachusetts, called on me and said that he had just come in from the Lynn Woods.

<sup>1</sup> Faxon, Walter and Hoffman, Ralph: Supplementary Notes on the Birds of Berkshire County, Massachusetts. Auk, Vol. XXXIX, No. 1, January, 1922, pp. 71, 72.

When at Lake Walden, sitting on a height overlooking the lake, he said that he looked down into the water and saw two Horned Grebes pursuing fish. The fish, which were there in great numbers, seemed to be pond minnows. Mr. Clark said that he could see the under-water movements of both birds and fish clearly. The birds seemed to open their wings partly and use them with quick, strong strokes in pursuing the fish under water. In catching the fish they darted the head and neck to right and left. Mr. Clark's notes were taken down at the time. In June, 1921, when I began to investigate the matter more fully, I wrote to Mr. Clark's companion on the Lynn Woods trip, Mr. Walter E. Bates of Lynn. He remembered the circumstances of the case, especially the perfect situation where they had observed the birds, which was on an elevated promontory from which, with the sun at their backs, they looked down at the birds so that their course through the water could be followed easily. He was not then aware of the importance of the observation. He recalls that the birds moved with marvelous speed, but he does not now remember positively whether or not they used their wings.

Mr. Ludlow Griscom of the American Museum of Natural History once saw a Horned Grebe off a Long Island beach "actually flying under water" while catching small fish. The wings were about one-third spread and used in quick strokes; both feet were used also and struck together except when turning quickly: then only one was used. Mr. Erle L. Brown, Bowdoinham, Maine, says that he has seen Horned Grebes several times using both wings and feet under water at Merry-meeting Bay. The wings were used with quick strokes, and the foot-strokes alternated one after the other. The birds swam faster, he says, with wings and feet than they did with feet alone. Mr. Ralph Lawson, secretary of the Essex County Ornithological Club, Salem, Massachusetts, watched from a high wharf a Horned Grebe in the harbor of Cutler, Maine. The bird was feeding along the bottom, pursuing an irregular course, and using both feet and wings. It seemed to be picking up something from the bottom. Mr. Stanley G. Jewett, Portland, Oregon, says that in March, 1916, at Netarts Bay, Oregon, he saw a Horned Grebe swimming under water with wings about

half spread and used with quick strokes. The feet also were used, both feet striking together, apparently alternating with the wings. When the bird used its wings it swam faster than when using the feet alone. Rev. Charles J. Young reports that in May and June, 1920, at the head of Brighton Bay, Lake Ontario, where Horned Grebes breed commonly, he saw them swimming under water with the wings partially spread and moved with slow strokes. The feet apparently were not used, except possibly as a rudder, as they were extended straight out behind.

Mr. Waldo L. McAtee, the well-known economic ornithologist of the Biological Survey, notes that in 1903 he saw a Pied-billed Grebe swimming with wings spread at least at right angles to the body and "stroked rapidly." He believed that the feet also were used.

There is more evidence regarding the subsurface movements of the Pied-billed Grebe than of any other, as this is the most generally common and widely distributed grebe breeding in the United States. Dr. Walter H. Scudder, Litchfield, Ohio, reporting on an unwounded Pied-billed Grebe that he kept in a tank, says that in swimming under water it raised the wings and held them along the sides of the body, so that they acted like the blades of a turbine, the water passing under them at the shoulder and gliding along their under sides and out behind with a swirl. The feet also were used, and the quick strokes alternated almost faster than the eye could follow. The bird used the wings and feet in this way all the time, so far as he could determine, and swam with great speed. Mr. H. E. Tuttle, Groton, Massachusetts, speaks of pursuing at Huron Mountain, Michigan, a Pied-billed Grebe which passed under his canoe. He attempted to catch the bird in a landing-net. It was using its wings. He could not tell whether the feet were used or not. The speed of the bird was undoubtedly accelerated by the fact that it was pursued.

Mr. George M. Sutton of the Carnegie Museum at Pittsburgh says that young Pied-billed Grebes in a small pond near Winnebago City, Minnesota, used their wings constantly. As he remembers it, the wings were not fully spread most of the time, but only when occasion demanded. Both wings and feet

were used. When closely pressed the birds used their wings to advantage in increasing their speed. Mr. Ralph H. Holman, Wellesley Hills, Massachusetts, makes note of an occurrence in the autumn of about 1890, when he saw a Pied-billed Grebe in Lake Quinsigamond, Worcester, Massachusetts. The wings were about half spread and used with quick strokes. Mr. David H. Scott, Iowa City, Iowa, reports that in the fall of 1918, at Emmetsburg, Iowa, he saw a Pied-billed Grebe swimming beneath a bridge on which he was standing. The bird was in clear water and only two or three feet below the surface. According to his notes of observation the wings were not over half extended, and they beat very fast in short, quick strokes. Both wings and feet were used, the feet alternating as in walking. A beat of the wings seemed to go with each stroke of a foot, the feet moving more slowly in comparison to the wings.

Mr. Robert O. Morris, the well-known ornithologist of Springfield, Massachusetts, writes that he saw a Pied-billed Grebe, which spent a number of weeks in small ponds in Forest Park, Springfield, and became quite tame. Apparently it used its wings under water. Mr. Scott Harrison, Lawrenceville, Illinois, says he has seen Pied-billed Grebes with wings spread under water, but did not note how the wings were used. Mr. Charles L. Phillips, Taunton, Massachusetts, found a Pied-billed Grebe on October 10, 1885, at Dighton, Massachusetts, concealed under a bank of a small stream. Upon his quiet approach the bird swam out under water. As it swam away, the wings were about half extended, and were used in short, quick strokes apparently in unison with the feet. It moved very fast in two or three feet of water. Mr. George L. Fordyce, Youngstown, Ohio, reports that he was in a boat approaching a narrow inlet to a small bay in which was a Pied-billed Grebe. The Grebe dived and as Mr. Fordyce rose in the boat, he saw the bird swim beneath, using its wings and moving fast. He saw no motion of the feet, but the wings seemed to be used much as a swimmer uses his arms, although not so rapidly as in flight. Mr. Edward S. Butler, Baines, Louisiana, in 1918, observed a Pied-billed Grebe swimming under water in a creek near his home. He says, "I think the wings were fully spread

and used with quick strokes;" but he is not positive as to just how much they were spread. The feet also were used, and the strokes seemed to alternate with those of the wings. Mr. Bonnycastle Dale, The Hawk, Cape Sable, Nova Scotia, writes me that while standing on a bridge over the Sooke River in British Columbia he saw a Pied-billed Grebe coming up swiftly through the clear water. Soon it dived and swam down by using its wings with strong sweeps "just as a diving man would use his arms." It soon reached the bottom and kept itself in an inverted position by "treading water upward," or kicking toward the surface. While thus holding itself in place with its feet it turned over small stones with its bill, evidently seeking the little crabs with which this river abounds below the limit of tidewater. Mr. Dale believed the river to be about 20 feet deep at this point, and was certain that the bird used only its wings to take it down and only its feet to keep it in position. In coming up it did not appear to use either wings or feet, but seemed to shoot up by means of its buoyancy.

Mr. Alfred Cookman, San Diego, California, reports that on April 15, 1916, while watching from a blind on the shore of a slough for the purpose of studying the diving habits of the Ruddy Duck, he saw a male Pied-billed Grebe on the water within 10 feet of the blind. The bird suddenly dived. Both water and sky were clear. The hour was 10.30 A.M., and the average depth of the water was 3 feet. "The bird dived at an angle, using its wings as a seal would use its flappers; broad strokes; vigorous action; feet not used. He went to the very bottom, turned sharply, rose at an angle and vanished. Mud came to the surface. The depth at that point was 2 feet 3 inches." As the bird struck out after reaching bottom, Mr. Cookman notes that it paddled with its feet, and that the wings moved forward and backward laterally with rapid strokes, about one beat of the wings to every downward paddle of the feet. In twenty seconds the bird appeared on the surface at a distance of about 40 yards. This observation was made on the east branch of Nigger Slough, Los Angeles County, California. He also has watched several Pied-billed Grebes in Dominguez Slough in the same county, and from his experience expresses the belief that this species uses its wings mainly for locomotion beneath the surface.

Mr. J. Warren Jacobs, Waynesburg, Pennsylvania, watched a Pied-billed Grebe diving in the clear water of Tenmile Creek, south of Waynesburg. He was with a companion, and both threw stones at the bird, not to injure it but to see it dive. They followed it, one on either side of the creek. It came up twice near where Mr. Jacobs stood on a high bank. It used its wings both in rising and diving. Mr. Jacobs says:—

While it was under water, we moved to where we surmised the bird would appear, and sometimes we guessed right.

As some authorities insist that European grebes do not use the wings under water, some evidence from European sources may be introduced to show that this statement is erroneous.

Johns, writing of the Little Grebe, says:—

It seeks safety, and this it finds first by diving and then by propelling itself by its wings under water.

He describes a large, beautiful spring, clear as crystal, and says:—

I was once bending over the bank of this spring with a friend, watching the water some 5 or 6 feet down, . . . when there suddenly passed between us and the bottom a form so strange that we were at first doubtful to what class of animals we should refer it. In reality it was a Dab-chick, which, alarmed probably by the noise of our conversation, was making for a place of safety. As it passed within 2 or 3 feet of our faces, we could distinctly see that it propelled itself by its wings.<sup>1</sup>

The bird did not see them, so was not greatly frightened.

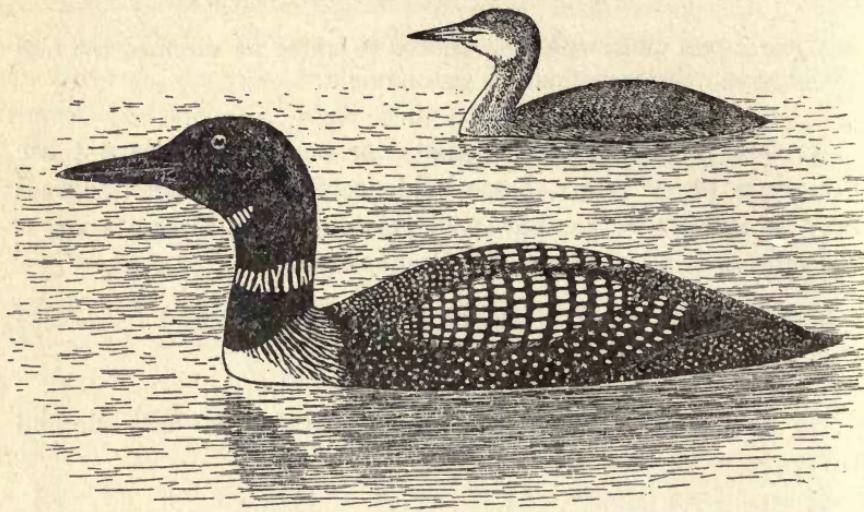
My assistant, Mr. Arthur J. Parker, says that once on the Trent River in England he watched a Little Grebe swim directly under a bridge on which he was standing and about 3 feet below the surface. The progress looked more like flying than swimming, — the feet were not visible, but the wings were used in a uniform succession of strokes, being quite widely though perhaps not fully expanded for each propulsion. More evidence might be given, but enough has been adduced to disprove the assertion that grebes do not use their wings in under-water progression.

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<sup>1</sup> Johns, Rev. C. A.: *British Birds in their Haunts*, 1909, p. 303.

## UNDER-WATER SWIMMING OF LOONS.

A number of my correspondents have made observations which might sustain the belief that loons do not use their wings under water. Mr. William E. Praeger, Kalamazoo, Michigan, and Mr. Walter B. Johnstone give testimony to sustain this



Summer.

Winter.

LOON (*Gavia immer*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

The Loon uses both wings and feet in diving and swimming beneath the surface.

contention. Mr. Lee S. Crandall of the New York Zoölogical Park says that he has observed Loons (Great Northern Divers) in a glass tank, and so far as can be seen the wings are not used. Mr. Roy Latham says that he has observed many Loons in fish-traps. He asserts that the wings are not used there but are sometimes slightly lifted and held motionless. Dr. Charles H. Townsend of New York City, in the Bulletin of the New York Zoölogical Society (April, 1908, page 418), asserts that a Loon which was received in September, 1907, at the aquarium, of which he is the director, and which was kept in one of the large salt-water pools, swam under water with wings closely folded and never in use. Professor Lynds Jones, Oberlin, Ohio, notes that in the summer of 1904 he watched a Loon in a big tank at Woods Hole, Massachusetts. This bird,

he says, never used its wings in swimming, although it swam with incredible swiftness. Mr. Harry A. Cash, Providence, Rhode Island, saw a Loon on Cape Cod pass out through a narrow, shallow stream in making its escape to the open water. This bird swam under the water, but did not use its wings. It was not wounded and had not been frightened by shooting.

Nevertheless, in the literature of American ornithology there are a few observations regarding the under-water use of the wings by Loons. Audubon says:—

Having myself seen Loons pass and repass under boats, at the distance of several feet from the surface, and propel themselves both with their feet and their half-extended wings, I am inclined to believe that when not wounded and when pursuing their prey, they usually employ all their limbs.<sup>1</sup>

Nuttall writes as follows about a Loon which he kept in a fish-pond, which was an indefatigable diver:—

and would remain down sometimes for several minutes, often swimming under water, and, as it were, flying with the velocity of an arrow in the air.<sup>2</sup>

Dr. Suckley followed a slightly wounded Red-throated Loon along the banks of a shallow lagoon from which it attempted to escape into the open waters of the Straits of Fuca. He was obliged to "run as fast as possible to keep up with it." The water was clear and shallow and he could see its motions distinctly. "The head and neck were extended nearly straight, and, in addition to the ordinary propulsion by the feet," the bird "used the wings exactly as if flying."<sup>3</sup>

Dr. Coues, who had an excellent opportunity in 1865 to watch Pacific Loons in the Bay of San Pedro in southern California, says that these birds were remarkably numerous and very tame. He had no difficulty in securing all the specimens that he wanted or in watching their under-water activities. He states that he could follow their course and "see them shoot with marvelous swiftness through the limpid element, as, urged

<sup>1</sup> Audubon, J. J.: *Ornithological Biography*, Vol. IV, 1838, p. 51.

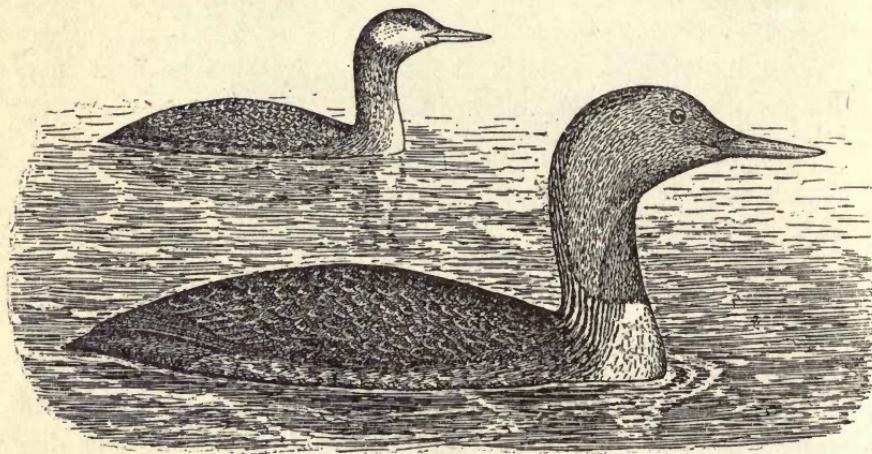
<sup>2</sup> Chamberlain, Montague: *A Popular Handbook of the Ornithology of the United States and Canada*, based on Nuttall's *Manual*, Vol. 2, 1891, p. 390.

<sup>3</sup> Suckley, George, and Cooper, James Graham: *The Natural History of Washington Territory and Oregon*, 1860, p. 280.

by powerful strokes of the webbed feet and beats of the half-opened wings, they flew rather than swam." He saw them catch fish in this manner and lightly rise to the surface again.<sup>1</sup>

Dr. T. S. Palmer's observations corroborate those of Dr. Coues. In the spring of 1885 he had an unusual opportunity to watch the subsurface behavior of the same species in Bodega Bay, California. The mode of progression, he says, with both feet and wings, might be described as partly swimming and partly flying, the wings being somewhat extended so that the birds were able to make rapid progress.

Goss avers that he often lay upon a railroad track at its crossing of a narrow outlet to a small pond and watched the



Winter.

Summer.

RED-THROATED LOON (*Gavia stellata*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

This species, like other loons, uses both wings and feet in under-water progression.

Loons pass and repass, invariably coming and going with the tide. As they approached the outlet, "they would dive at a safe distance and with the aid of their wings fly beneath its surface with the speed of an arrow; making the water fairly boil around them, and leaving in their wake a silvery streak of bubbles."<sup>2</sup>

<sup>1</sup> Coues, Elliott: Birds of the Northwest, 1874, p. 723.<sup>2</sup> Goss, N. S.: History of the Birds of Kansas, 1891, p. 17.

There is some evidence from European writers that loons use their wings in diving and swimming. Johns says:—

I am informed by a friend that while fishing in a boat in calm water off the coast of North Devon, he has many times seen Divers [Red-throated Loons] pass through the water, at a considerable depth below, propelling themselves by a free and active use of their wings.<sup>1</sup>

Dresser says of the Red-throated Loon:—

When it dives it . . . propels itself along with its wings as well as with its feet.<sup>2</sup>

MacGillivray says of this species:—

Under the water it pursues its way with great speed, using its wings as well as its feet.<sup>3</sup>

Mr. Alfred Cookman, San Diego, California, asserts that the Red-throated Loon uses the feet "alternately with the wings."

Many of my correspondents who have had opportunities to observe Loons swimming below the surface report similar use of the wings.

Dr. B. Harry Warren, West Chester, Pennsylvania, reports that he has seen Loons using their wings under water.

Mr. Erle L. Brown, State Game Warden, Bowdoinham, Maine, who saw in the spring of 1921 a Loon swimming beneath the surface, says that the "first joint" of the wing was used in quick strokes; that both wings and feet were used and that the strokes of the feet alternated one after the other, also that the Loon swam faster when using the wings than when using the feet alone. Dr. Walter H. Scudder in 1886 watched a Loon swimming in a canal lock at Akron, Ohio. This bird raised its wings and held them stationary, while it propelled itself with its feet. Mr. Ralph Lawson writes that on several occasions he has seen Loons use their wings under water; and has no doubt that it is a common means of covering distance quickly when occasion demands. He mentions a particular instance when with one companion he pursued a Loon in

<sup>1</sup> Johns, C. A.: *British Birds in their Haunts*, 1909, p. 297.

<sup>2</sup> Dresser, H. E.: *Birds of Europe*, Vol. VIII, 1871-1881, p. 625.

<sup>3</sup> MacGillivray, Wm.: *British Birds*, Vol. V, 1852, p. 304.

Thorndike Pond, Jaffrey, New Hampshire. They were in a canoe, and seeing the bird in the pond decided to chase it, knowing that the absence of wind would make it difficult if not impossible for it to fly. They followed it for more than half an hour, and several times saw it pass directly under the boat. On each occasion the bird was using its wings with what Mr. Lawson calls "half-strokes." The occupants of the canoe were skilled paddlers, and finally pressed the Loon so closely that it was unable to stay under water long, and its labored breathing could be distinctly heard.

Mr. Winthrop Sprague Brooks of the Boston Society of Natural History asserts that years ago he saw a Loon in a tank at Woods Hole, Massachusetts, and that, as he remembers, it used its wings exclusively under water. Mr. Henry W. Abbott of Boston tells of a wounded Loon that fell on the sand beach at Pine Point, Maine. He landed from his boat and the Loon reached a narrow rivulet and swam under water with both feet and one wing. The other wing presumably was injured. Under these circumstances the Loon swam in a circle.

Mr. A. B. Howell, Pasadena, California, says that a wounded Loon swam under his boat when he had the bird partly cornered, and, as the surface of the water was ruffled, all that he could be sure of was that the bird used its wings in some way.

Rev. Charles J. Young, Brighton, Ontario, asserts that he has seen Loons swimming below the surface at Lake Ontario. This occurred in June, 1921. The wings were used with slow strokes.

Mr. Nathan F. Leopold, Jr., of Chicago writes that he saw a Loon at Plum Lake, Wisconsin, swimming and using its wings under water. It was a common breeder there and allowed close approach in a canoe. The wings were only slightly spread and were moving in quick strokes. The feet were used with the wings, and he believes that the bird swam faster with the aid of the wings than with the feet alone.

Mr. Albert W. Honywill, Jr., Hartford, Connecticut, reports that he observed a wounded Loon swimming under water. An attempt was made to capture it from the launch but it dived and swam past the side of the boat 3 or 4 feet below the

surface and about 10 feet distant. The wings were used quite rapidly and were approximately half opened, as nearly as he could determine. Both wings and feet were used. The wings and feet appeared to co-ordinate, and made the back-stroke in unison.

Mr. Bertram S. Griffin, Haverhill, Massachusetts, notes that in July, 1900, one of his friends saw a Loon using its wings under water at Bear Pond, South Waterford, Maine. The wings were half spread and used in quick strokes and with the feet. His friend has observed this on several occasions.

Mr. Arthur W. Beckford, Danvers, Massachusetts, writes that he saw a Loon swimming under water in a narrow salt-water stream, and using its wings when followed by a power boat. Quick, short strokes were employed, but he believes that the wings were used more for the purpose of turning than for progression. The feet also were utilized, but he was unable to tell whether both feet and wings were used together.

Mr. Arthur L. Clark, Ithaca, New York, says that in June, 1911, at White's bridge, which crosses a narrow strip of water at the south end of Sebago Lake, Maine, he saw a Loon swimming four or five feet below the surface and against the current.

The wings were not fully spread, but were taking about half-strokes or less, *i.e.*, short, steady strokes. The wing-beats could not be called quick, but rather about normal for a Loon. The feet were not seen.

Mr. Charles K. Averill, Bridgeport, Connecticut, says that as he sat on a rock on the shore of a small lake in the Adirondacks a Loon passed near under the surface of the water. The wings were spread, but not so widely as in flight. They were used with a motion "much slower than when flying and with not so extensive a sweep."

Dr. William C. Braislin, Brooklyn, New York, says that he saw a wounded Loon in shallow water in Great South Bay, Long Island. The wings were spread to less than half their extent, he thought, and in locomotion were quickly jerked against the sides again. They were used to supplement the feet in swimming. The feet, he assumes, were the chief means of locomotion, but doubtless were greatly aided by the wings,

judging from the speed made. He is not sure that all strokes of the wings and feet were simultaneous, as he saw the bird (while near at hand) quite vertically, as he was sitting in the stern of a small boat, the Loon passing quickly beneath; but he believes that they were.

Mr. Edmund W. Arthur of Pittsburgh observed some Loons in July, 1917, in a small inlet near Manitou Dock, Georgian Bay, Ontario. There were two adult Loons and two half-fledged young. Mr. Arthur, with his companion, Hon. R. A. Kennedy, pursued one of the young birds for twenty minutes or more with a rowboat, hoping to tire it. During a large part of the time, writes Mr. Arthur, it was seen swimming under water within 4 to 10 feet of the boat. The wings were raised apparently almost at right angles to the body in making the stroke. Wings and feet were used and both swept back together. The observers did not see the feet used alone at any time. Judge Kennedy told Mr. Arthur that he had had similar experiences on two prior occasions.

Mr. John L. Cole, Nevada, Iowa, writes me that in October, 1906, he saw a Loon in an ice pond. The bird did not fly, but on his approach dived, making use of its wings in swimming under water. The wings were half extended and quick strokes were used. Both wings and feet were used, and moved together. The wing movements were very pronounced and put one very much in mind of those made by the legs of a frog when swimming. The bird swam very much faster when using wings and feet than when using feet alone.

Dr. William S. Bigelow, 56 Beacon Street, Boston, writes that in 1865 he saw a loon, species unknown, at the North Pond, Tuckernuck Island, Massachusetts. This loon, he says, used its wide-spread wings under water.

Mr. Owen Durfee of Fall River, Massachusetts, reports that on July 4, 1915, in a small lake in Penobscot County, Maine, he found a female Loon with a young bird evidently only a few hours old. He saw the little bird dive and swim perhaps 30 feet under water. It continued diving but soon became tired, and before he left was swimming not more than 6 or 8 inches under water and going not more than 10 feet at a time. Apparently the little wings were held out from the sides and

worked to some extent, but not fast. The feet were paddling alternately, and with every few kicks the wings were simultaneously struck downward and held half open again during a few more kicks before another flap.

Mr. Kenneth C. Gurney, East Stoneham, Maine, reports that he saw a Loon in Keywadin Lake swimming under his canoe with the wings spread about 8 inches and used with quick motions. Apparently only the "first joint" of the wing was used. The bird was only about 12 or 15 inches below the surface, and the motion of the wings could be clearly seen. Both wings and feet were used. The feet were used alternately. He is positive that the bird swam very much faster when using the wings than when using the feet alone.

Mr. B. K. Lewis, North Eastham, Massachusetts, writes that he headed a Loon up into a cove where the water was shallow and the bottom sandy. The bird could be seen very plainly. It seemed to make a backward movement with its wings. It was going very fast. Mr. Albert A. Cross of Huntington, Massachusetts, says: —

I have seen a Loon swimming under water in L'Assomption River, Province of Quebec, and the bird used its wings, keeping them extended and vibrating them rapidly. As I was above the bird I could not see its feet.

Mr. Bonnycastle Dale writes as follows of a Loon seen in May, 1918, at Rice Lake, Ontario: —

In approaching the Loon's nest we got in front of the bird, which put its head down, stretched out its neck and slid off the nest into the water, then swam right under the canoe within about 2 feet of the surface, the water being about 4 feet deep. This Loon was swimming with its wings only, its legs and tail apparently straight out behind, but I could not see the legs. The first Loon I saw swimming under water was off this same shore. We were in a canoe searching for the Loon's nest. Suddenly I saw right under us a big white thing, which at first I took to be a fish, then I saw it was a big bird swimming along, with both wings stroking swiftly. We paddled to the shore, some 100 feet away, and found the nest and the warm egg that the bird had just left.

Dr. L. C. Jones, Falmouth, Massachusetts, says: —

I have often observed wounded Loons swimming under water, and my impression is that short, sharp strokes of the wings were used ac-

cessory to the action of the feet, particularly when they were exhausted and frightened.

Mr. C. H. Weekes, Harwich, Massachusetts, writes: —

Some years ago at Tiverton River, Rhode Island, I noticed a Loon where the water was 3 or 4 feet deep, and the seaweed very dense and near the top of the water. This Loon was moulting and could not fly. We chased it with the boat and finally caught it. The water was very clear, and when nearing the Loon in our chase the bird used both wings and feet while under water.

Mr. W. A. Matheson, Barrington, Rhode Island, writes, regarding the same Loon: —

I saw the Loon which passed the boat at arm's length about 8 or 10 feet under water. It was making rapid progress with wings about half extended, and seemed to fly in the water. It must have also used its feet, as they were not extended back with the tail.

Major Mark Robinson, Algonquin Provincial Park, Ontario, says: —

I will give you my experience while watching a Loon pass under a bridge on which I was standing. This Loon was quite tame, as we do not allow any person to trouble them. It will sit and watch us at 10 feet distance, swimming easily. It uses only its feet to swim, but in pursuit of fish, etc., it uses the wings, keeping the long points of the wings close to the body. At the shoulder the wings appear to open to full extent. My son and I captured a pair of baby Loons by following them in a canoe. The young Loons did not use their feet at all in their frantic efforts to escape, and in their case the end of the wing was held close to the body with full play at the shoulder. I have questioned old guides and bushmen regarding the loon under water, and in every case their reply is, "Of course they use their wings to fish."

Captain George H. Mackay, Jr., writes that since Loons have been protected in spring at Nantucket under the Migratory Bird Treaty Act, they have become very tame, and come close to the wharf in the harbor. In January, 1921, he sat on the wharf within 20 feet of a Loon which was diving and swimming under water. The water was clear, and everything that the bird did could be seen. The Loon used its wings, spreading them quite widely, but perhaps not completely, and moved

very fast while swimming under water. It was diving to the bottom and catching small fish there. This, he says, occurs very often.

#### UNDER-WATER MOVEMENTS OF CORMORANTS.

The reader who has followed me thus far has noted much conflicting evidence regarding the under-water habits of grebes and loons. He will find similar contradictions in the statements of authors and observers about the under-water progression of cormorants. European authors do not agree about this. Headley says, referring to diving:—

The Cormorant uses his feet alone to propel him, striking with both simultaneously, and holding his wings motionless, though slightly lifted from the body. The position of the wings must have given rise to the idea, common among fishermen, that the Cormorant flies under water. . . . But when you see him in a tank you can have no doubt that the legs are the propellers.<sup>1</sup>

This idea that a bird in a small tank will act exactly as it would when free and in deep water has caused ornithologists to draw false conclusions. The keen-eyed fishermen who had watched the birds in their native haunts doubtless had much better opportunities to study their unhampered movements than were afforded to Headley by specimens confined in the limited area of a tank. One might as well study the habits of an eagle in a flying cage. Both the cage and the tank offer exceptional opportunities for observing captives, but such observations should never be regarded as conclusive in respect to the behavior of the free wild creature.

How the diving habits of water birds may be modified by confinement in a tank is indicated by the following passage from a letter from Dr. J. E. H. Kelso, Edgewood, British Columbia:—

Some years ago, in the London Zoo, I came across an interesting case of changed habits in birds. A keeper showed me a tank surrounded by rockwork, in which floated some guillemots. When feeding time came a bucket or two of dead or moribund small fish were emptied into the tank. The birds had to exert very little effort to secure their feed, and

<sup>1</sup> Headley, F. W.: *Life and Evolution*, 1907, pp. 125, 126.

I noticed a few did not use, or hardly used, their wings under water, but could easily secure the fish with a few strokes of the feet. The keeper assured me that when first introduced the birds all used the wings when swimming below the surface, but he thought they got nervous by striking their pinions against the glass, and soon found they could secure their food without use of the wings. I have always maintained that there is little use in observing captives in regard to habits.

Selous says of Shags observed in caverns in the Shetland Islands that the wings were not used at all, but were kept closed all the time while he watched.<sup>1</sup> But Seeböhm says of the same species that it uses wings as well as feet to aid in the chase.<sup>2</sup> Dixon says of Cormorants that "they seem to fly as readily under the water as through the air."<sup>3</sup>

MacGillivray writes as follows of the Green Cormorant:—

On looking down [in a lighted cave] we saw them rapidly wending their way under the water, flying with outspread wings, and not at all in the manner represented by some, who say that this bird propels itself under water by the feet and tail. Of this I am certain, having been an eyewitness of the fact.<sup>4</sup>

Audubon refers to an account published in "The Naturalist," regarding the under-water flight of the Dipper or Water Ouzel of Europe, in which MacGillivray says that its actions under water are precisely similar to those of divers, mergansers and cormorants, which he had often watched from an eminence as they pursued shoals of sand eels along the shores of the Hebrides. It flew, not using the wing from the carpal joint alone, but extending it considerably and employing the whole extent as if in air.<sup>5</sup>

Jordan, a lifelong observer of the habits of birds, remarks:—

The Cormorant uses its wings as well as its large paddles when diving.<sup>6</sup>

Dr. Hatch, who lived in Minnesota at a time when Double-crested Cormorants bred there locally in "innumerable num-

<sup>1</sup> Selous, Edward: *The Bird Watcher in the Shetlands*, 1905, p. 50.

<sup>2</sup> Seeböhm, Henry: *British Birds*, Vol. III, 1885, p. 657.

<sup>3</sup> Dixon, Charles: *Our Rarer Birds*, 1888, p. 347.

<sup>4</sup> MacGillivray, Wm.: *British Birds*, Vol. V, 1852, p. 396.

<sup>5</sup> Audubon, John J.: *Ornithological Biography*, Vol. IV, 1830, p. 495.

<sup>6</sup> A Son of the Marshes, [Jordan, Denham]: *Wild Fowl and Sea Fowl of Great Britain*, 1895, p. 304.

bers," and who spent much time in the field watching water birds, writes of them as follows:—

Being principally fish-eaters they spend most of their time in the water, where their movements in pursuit of their prey are simply marvelous in velocity. With their totipalmated feet folded flatly into mere blades while carried forward, and when struck out backwards opening to their utmost, and with the half-spread wings beating with inconceivable rapidity, they seem to fly through the waters at various depths in pursuit of their favorite food, the fish.<sup>1</sup>

It is difficult now to get much evidence from American observers regarding the diving habits of cormorants. On the Atlantic coast these birds have been so much persecuted that they are very shy. Opportunities to watch them under water in their usual haunts are exceedingly rare. On the Pacific coast the chances are better, and occasionally some one notes the subsurface activities of cormorants in the interior.

Mr. William E. Praeger says that he once saw a cormorant under water and that the wings were not used in swimming. Mr. Lee S. Crandall says that when cormorants were observed in a glass tank, so far as could be seen the wings were not used but were kept closed. Mr. E. F. Pope says that he has had much experience with cormorants, but never saw them make use of their wings when swimming under water. Mr. Louis Agassiz Fuertes says that cormorants customarily use wings as well as feet in swimming, but that they do not fly under water, as they use their wings half opened and loosely held as a sort of sculling aid in changing speed and direction. But he has seen this only in tanks, where the birds' movements were restricted.

Mr. Roy Latham, who has seen many cormorants in fish-traps, says that in a few cases the wings have been slightly lifted but held motionless as with Loons seen in the same circumstances. Mr. A. W. Anthony asserts that he has seen both Brandt's and Farallon Cormorants use their wings to a limited extent, the wings being slightly opened and used in connection with the feet.

Mr. W. Otto Emerson, Hayward, California, asserts that while watching from the cliffs of the Farallones he has seen

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<sup>1</sup> Hatch, P. L.: *Birds of Minnesota*, 1892, pp. 28, 29.

both Brandt's and Farallon Cormorants diving and swimming among the kelp and mussel-covered rocks. The wings were held "stiffly from the sides of the body," about two-thirds open. No apparent movement of the wings was noted. The feet were working fast. Mr. Ira N. Gabrielson writes from Portland, Oregon, that in August, 1921, at Netarts Bay, a Farallon Cormorant was observed to use its wings, which were merely lifted slightly while the feet were driving the bird. The Cormorant passed under his boat.

Mr. Alfred Cookman, San Diego, California, reports seeing, in the summer of 1917, near the Los Coronados Islands, Mexico, Brandt's Cormorants diving, using their wings as seals use their flappers.

Mr. Cookman's description follows: —

The Brandt's cormorants (about twelve) were feeding near rocks on the leeward side of South Island. Four birds were on the sea, the rest were on the ledges. The tide was low. The sea was very calm. We were on the rocks at tidewater level. The depth of the water there near shore varies from 6 to 25 feet. There was no beach, only ragged rocks. A male in nuptial plumage came toward the rocks. Sardines were plentiful and a school of them had entered the cove. He used his wings with broad expanse and forward and backward strokes. The feet were not used in locomotion beneath the surface except as he rose to the surface. Then I was able to get a quick glance, and I am certain that he used his feet in rising, assisted by rapid downward strokes of the wings.

On July 2, 1917, off North Island, one of the Coronados group, a female Farallon Cormorant rose to the surface 7 feet away, with her pouch filled. The water was clear, the sky gray, the sea calm. In rising she struck down with her feet and moved the wings with each stroke of the feet, the feet not striking together, but alternating.

Mr. Cookman also remarks that he has been able to watch these Cormorants diving to a depth of about 15 feet.

Dr. B. H. Warren, West Chester, Pennsylvania, writes that a wing-tipped Cormorant that he pursued used its wings under water in its efforts to escape.

Mr. J. H. Fleming, Toronto, Ontario, reports a Common Cormorant, in a tank at the London Zoölogical Gardens, as using its wings under water. He has seen the same species wild in the Scilly Islands under such conditions that he made certain that the wings were used. From memory he says that

only the fore part of the wing was used in quick strokes, while the feet were used for steering as well as for propulsion.

Dr. A. K. Fisher of the Biological Survey writes that on several occasions, while standing high above the water, he has seen cormorants flying under water; the wings were fairly well spread, but he could not see the feet.

Mr. G. Dallas Hanna, San Francisco, California, writes that, in the years between 1913 and 1920, he has observed Red-faced Cormorants about the Pribilof Islands, Alaska, using their wings. He watched them many times from sail boats and motor boats. The wings were never more than half spread, and the strokes were made at about the same rate as in flight through the air. The speed was not estimated to exceed ten miles an hour under water. This estimate was based on the speed of the boats. These birds appeared always to use their wings in diving.

Mr. Morton R. Cheeseman, Rivera, California, says that cormorants use their wings when diving for fish. When fishing from the long pier at Santa Monica he had an excellent chance to watch these birds, as there were usually several swimming about. The wings were spread as in the sketch, and were used with quick energetic strokes. He could not see the feet.



Diving position of cormorant, as sketched by Morton R. Cheeseman.

#### UNDER-WATER MOVEMENTS OF THE WATER-TURKEY.

It has been difficult to learn much about the movements of the Anhinga, or Water-Turkey, under water, because (1) we have comparatively few southern correspondents, and (2) usually the waters in which the Anhinga is seen are not clear. Audubon, who spent much time in swamps where this bird breeds, asserts that it does not use its wings for propulsion under water, but keeps them partly extended.<sup>1</sup>

Mr. Lee S. Crandall says of Water-Turkeys, observed in a glass tank, that as far as can be seen, the wings are not used beneath the surface but hang loosely, and Dr. Thomas Barbour, Cambridge, Massachusetts, states that he has seen Water-Turkeys in a large glass aquarium, but that they did not use

<sup>1</sup> Audubon, John J.: *Ornithological Biography*, Vol. IV, 1838, p. 143.

their wings even in chasing fish. Mr. Louis Agassiz Fuertes says that Anhingas customarily use the wings as well as the feet in swimming, but that they do not "fly" under water, but employ the wings half open and loosely held as a sort of sculling aid to speed and direction. But he says that he has seen them do this only in tanks. Mr. Oliver P. Medsger and others who have watched these birds in tanks corroborate this.

On the other hand, we have a little evidence from the field. Mr. Charles J. Pennock asserts that on September 26, 1914, on the St. Marks River in Florida, he chased a Water-Turkey that was wounded in the body, and saw it using wings two or three times, when in shallow water, to hurry from the boat. The motion of the wings was not rapid but frequent, and he and his companion felt sure that both wings and feet were used for propulsion. They followed the bird with a launch, and once more saw it with the wings in motion under water. Mr. Harry A. Cash, Providence, Rhode Island, says that while sailing in a small boat down a salt-water river in Cuba he saw a Water-Turkey come around a wooded point, and at sight of the boat dive into the water. It passed the boat swimming under the surface; "the wings were about half open and used with short, quick, jerky strokes, the legs were held stiffly out behind." The bird was not wounded or frightened by shooting.

Mr. C. P. Ward, Bruce, Florida, states that he has seen the Water-Turkey using its wings under water. They were about half spread and were merely lifted, but were used in quick strokes when turning. The feet also were used.

Often I have followed Water-Turkeys in boats, but never have been able to get near enough to see their mode of progression under the dark waters of southern rivers. Once I saw a young bird half-grown and covered with light down spring from its nest, dive into shallow water and swim away. It could be seen plainly; its motion was frog-like, and its wings somewhat extended, but as thirty-five years have elapsed since then I cannot now make a positive statement regarding whether or not the wings were used in propulsion. My recollection is that they were not so used.

From the foregoing we may deduce that, as hereinbefore stated, birds in their under-water activities do not follow our

rules. The evidence regarding many diving birds is similar to that obtained in respect to Water Ouzels. One observer sees the Ouzel or Dipper walking on the bottom with closed wings. Another sees it running there with wings raised, slightly extended and held stiffly "to keep it down." Another reports that it flies under water with wings alone, while still another avers that it uses both wings and feet in swimming beneath the surface. There seems to be even greater diversity in the activities of the diving birds. They swim beneath the surface with wings tightly closed, or raised and held loosely, or held close to the body and used in either quick or slow strokes, or well extended, or partially extended, or not extended at all, but merely raised and beating. The carpal joint is not used in some cases or at some times, and is employed in others. The wings sometimes keep time with the feet, whether both feet strike together or are used alternately, but sometimes the wing-strokes are faster than those of the feet, and sometimes the feet are used more rapidly than the wings, while at other times the feet are extended behind and used apparently in steering. In fact, the birds do just as they please, exactly as would a man in diving and swimming. Apparently in pursuing swift fishes or other birds, or in escaping from man, sharks or any other swift or powerful enemies, birds use both feet and wings to make great speed, and only because they can swim faster in that way than in any other.

Grebes in the shallow marshes in which they breed, where under water they have little use for the wings which would be more or less impeded by vegetation, and where often there are no fish for them to pursue, very likely often depend on foot power alone, but when they or other diving birds need the wings, or care, for any reason, to employ them beneath the surface, they use them as a matter of course.

For observational purposes the field ornithologist needs two structures that have never yet been employed in his work. First, a watch tower from which he can observe the habits of marsh birds, and the under-water activities of birds in sloughs and shallow ponds; and second, a submarine boat with windows of heavy glass, from which he can watch the deep-water activities of the diving birds. Of the deep-water movements of

diving birds we know nothing. Most of our observations on their subsurface progression have been made with birds in tanks, or just beneath the surface of the water. Ordinarily we lose sight of them when they leave the surface, or immediately afterwards. Usually under the most favorable conditions birds cannot be seen plainly much farther below the surface than 15 or 20 feet. There are reasons for the belief that some of the diving birds go to the bottom in more than 100 feet of water. Thoreau<sup>1</sup> gives on the authority of the newspapers the statement that a fisherman caught a Loon in Seneca Lake, New York, 80 feet beneath the surface with hooks set for trout, and says that Miss Cooper has made a similar statement.<sup>2</sup>

Bacon gives evidence that the Old-squaw when feeding in the Great Lakes is taken in large numbers in gill nets at a depth of 15 fathoms, and rarely at 27 fathoms (162 feet).<sup>3</sup> Mr. G. Dallas Hanna of the University of California writes me that he has taken freshly swallowed Crested Auklets from the stomachs of codfish which were caught on the bottom in water 200 feet deep, but this is not conclusive proof that the birds ever dive to that depth.<sup>4</sup>

Probably in deep diving the bird must prepare itself for long submersion by first filling the lungs with air. To force its buoyant body to great depths must require extreme propulsive efforts. By far the largest propelling surface about a bird is that of the wings, and the pectoral muscles that give them force are much the largest and most powerful in the bodies of all flying birds. Therefore we may assume that if the propelling power of the wings can be directed backward, they must give a greater impetus than that given by the feet. However, we do not yet know how directly the wing power can be applied in diving.

It seems probable that in deep diving the wings are always used and probably the feet also. Dewar has timed diving birds. He gives the time required to reach a certain depth and return to the surface. The rule, he says, is twenty seconds for the

<sup>1</sup> Allen, Francis H.: *Notes on New England Birds*, by H. D. Thoreau, 1910, p. 5.

<sup>2</sup> Cooper, Susan Fennimore: *Rural Hours*, 1850, p. 10.

<sup>3</sup> Bacon, Samuel E., Jr.: *Ornithologist and Oologist*, Vol. 17, March, 1892, p. 45.

<sup>4</sup> There is much additional evidence, however, that diving birds reach a depth of more than 100 feet.

first fathom, and ten for every fathom thereafter.<sup>1</sup> If I understand this rule correctly it would require about three minutes for a bird to descend 100 feet and return to the surface, and over five minutes might be required for 200 feet. A Merganser, held under water, was drowned in five minutes, and I do not recall any authentic instance where birds diving naturally in water a few fathoms in depth, and coming up undisturbed, have remained beneath the surface more than three minutes, although periods of four and five minutes have been reported. Therefore it is probable that birds by use of wings and feet are able to make faster time in descending to the depths than they ordinarily make in diving in shallow water. Otherwise they would have little or no time to feed on the bottom.

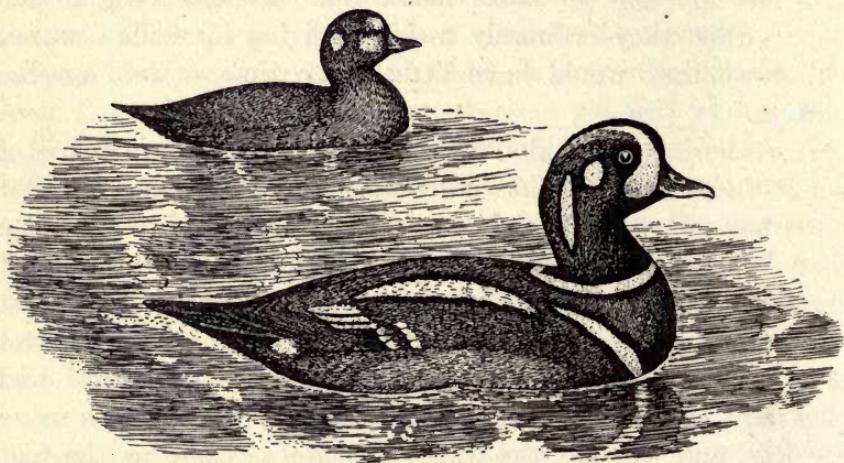
In reviewing the evidence that we have regarding the use of wings under water, I find no comparisons that assure us that birds move faster below the surface by the use of wings alone than by use of the feet only. But assuming for the sake of argument (1) that the wing-surface used under water is at least three times as large as that of the feet, (2) that the pectoral muscles which assist in propelling the wings downward and backward are perhaps three times as large as those which move the legs, and (3) that the wing-beats are as rapid as the foot strokes (and allowing that the propulsive force of the wing can be fully applied), we might well believe that birds move faster under water with wing propulsion than with foot propulsion. However that may be, we have seen that in the case of loons and grebes the birds apparently move faster when both wings and feet are employed than when the feet only are used. Some say faster, others much faster, and others *very much faster*.

In this preliminary report nothing more need be said concerning the behavior of the families under consideration. Considerable evidence has been collected in respect to the under-water behavior of several families of diving birds. This must await another opportunity for publication.

<sup>1</sup> Dewar, J. H.: British Birds, Vol. XIII, No. 12, May 1, 1920, p. 315.

## DO WOUNDED DIVING BIRDS EVER COMMIT SUICIDE?

Every wild-fowler knows that wounded diving birds often disappear under conditions which indicate that they have gone to the bottom and died there, and many duck gunners of long experience can narrate instances where they have actually found birds clinging to the bottom, or have seen their dead bodies rise to the surface after long immersion. Often the disappearance of such birds may be explained by the fact that they are able to swim long distances under water and then con-



Female.

Male.

HARLEQUIN DUCK (*Histrionicus histrionicus*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

The Harlequin has been known to dive when wounded and cling with its bill to vegetation until death. (See page 41.)

ceal themselves in vegetation near or on the shore, or they may even come to the surface, merely thrusting up the bill for breath from time to time and thus escape detection in rough water. But there are many occasions in wide, still waters where such methods of escape are impossible. Several ornithologists have made definite statements about the stratagems used by birds to escape the pursuer. Samuels says of the Old-squaw:—

It is a difficult bird to kill, and when wounded it will dive and cling to the bottom, where it dies.<sup>1</sup>

<sup>1</sup> Samuels, E. A.: Birds of New England, 1870, p. 518.

Again he says of the scoters: —

A wounded coot is a difficult bird to secure, especially if he happens to be a sagacious black White-wing. Often he will submerge all of his body, leaving only his bill out of the water, and sometimes will dive, keeping hold of the kelp on the bottom and dies in that position.<sup>1</sup>

Elliot says of the Red-head: —

When all other means fail it will dive to the bottom, seize some grass in its bill and hold on till life is extinct — commit suicide by drowning, in fact, rather than fall into the hands of its pursuer.

He says practically the same thing of the Lesser Scaup and the American Scoter, and he says also of the latter: —

If wounded it will frequently seize some grass at the bottom, as already related of other deep-water ducks, and commit suicide by drowning rather than permit itself to be captured. If the water is clear the bird can be seen close to the bottom, and if an oar can be made to meet it, by repeated pushes, it can be compelled to release its hold, when it usually rises to the surface, although sometimes it will swim to another clump of grass and hang on to that.<sup>2</sup>

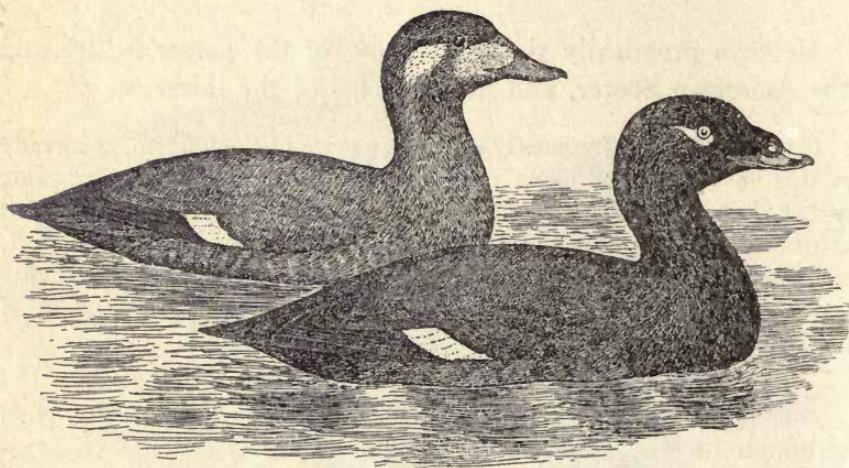
Elliot, however, does not say that he himself has seen this, although he was an experienced sportsman as well as an ornithologist, nor does he tell how the bird attaches itself to the vegetation; but Mackay, also an experienced sportsman and ornithologist, is more definite. Writing of the scoters he gives a definite instance and shows how the bird holds on: —

When wounded and closely pursued, they will frequently dive to the bottom (always using their wings as well as feet at such times in swimming under water) and retain hold of the rockweed until drowned, preferring to die than to come to the surface to be captured. As an instance of this, I may mention that on one occasion I shot a scoter when the water was so still that there was not even a ripple on its surface; after pursuing the bird for some time I drove it near the shore, when it dived and did not reappear. I knew it must have gone to the bottom, as I had seen the same thing repeatedly before. As the occasion was a favorable one for investigation, the water being clear and not more than 12 or 15 feet in depth, I rowed along carefully, looking continually into the water

<sup>1</sup> Samuels, E. A.: *With Rod and Gun*, 1897, p. 408.

<sup>2</sup> Elliot, D. G.: *The Wild Fowl of the United States and the British Possessions, or the Swans, Geese, Ducks and Mergansers of North America*, 1898, pp. 158, 166, 207-208.

near the spot where the bird was last seen. My search was at last successful, for on getting directly over where the bird was I could look down and distinctly see it holding on to the rockweed at the bottom with its bill. After observing it for a time I took one of my oars and aiming it at the bird sent it down. I soon dislodged it, still alive, and captured it. I have often seen these birds, when wounded and hard pressed, dive where the water was 40 to 50 feet deep and not come to the surface again. I therefore feel confidence in stating that it is no uncommon occurrence for them under such circumstances to prefer death by drowning to capture. This they accomplish by seizing hold of the rockweed at the bottom, holding on even after life has become extinct.<sup>1</sup>



Female.

Male.

WHITE-WINGED SCOTER (*Oidemia deglandi*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

It is not an uncommon occurrence for Scoters of all species, when wounded, to dive, hold on to vegetation at the bottom with the bill, and die there.

Mr. W. E. Clyde Todd of the Carnegie Museum at Pittsburgh quotes Bacon as follows:—

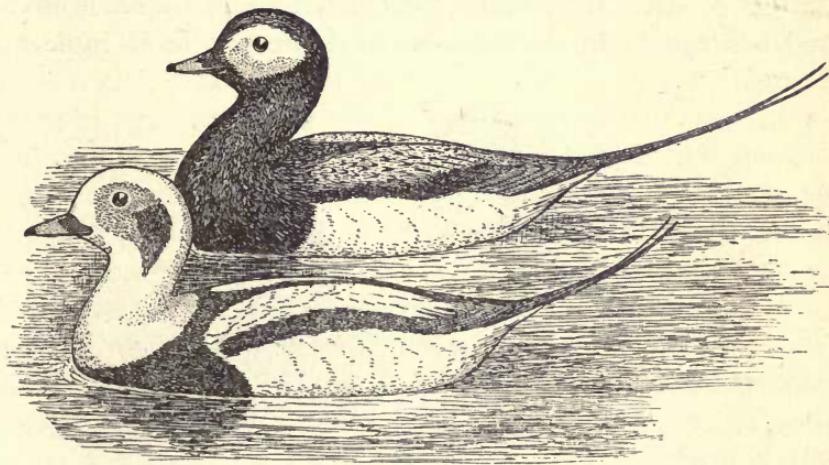
I once wounded a duck of this species [Lesser Scaup] in shallow water, and wading out to where I saw it last, I found it holding to a strong weed by its bill two or three feet below the surface, stone dead.<sup>2</sup>

Mr. Samuel E. Bacon, who is responsible for this statement, is referred to often by Mr. Todd, who regards him as a conscientious observer of large experience.

<sup>1</sup> Auk, Vol. VIII, 1891, pp. 282-283.

<sup>2</sup> Todd, W. E. Clyde: "The Birds of Erie and Presque Isle, Erie County, Pennsylvania." Annals, Carnegie Museum, Vol. II, No. 1, 1903, p. 521.

In the year 1912 I published in "A History of the Game Birds, Wild-Fowl and Shore Birds" a statement similar to those of Elliot and Mackay in regard to Scoters. This assertion was made on the authority of many people who claimed to have witnessed such behavior on the part of these birds, but since then I have come to doubt whether a bird ever actually commits suicide. I have always felt that if death occurred in this way, it must have been unintentional. On the other hand, it



Winter.	Males.	Summer.
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### OLD-SQUAW (*Harelda hyemalis*).

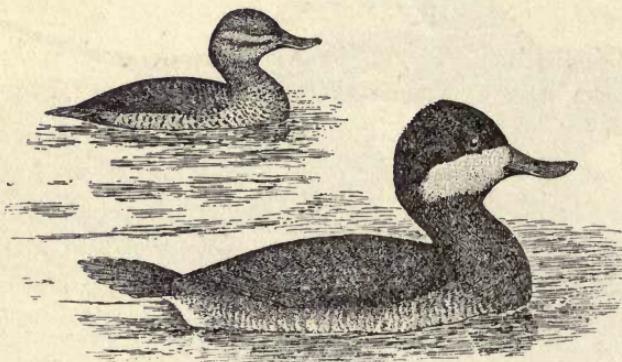
(From "Game Birds, Wild-Fowl and Shore Birds.")

Samuels says that Old-Squaws when wounded die clinging to vegetation at the bottom.  
(See page 34.)

seems to be a common happening for wounded ducks of several species to attach themselves to some growth under water and to hold on as long as possible. Nevertheless, many cases of disappearance can be explained in some other way. Wounded birds may be seized and swallowed by large fish or turtles, or when weakened by wounds they may be held down on the bottom by large shellfish, or entangled in rank growths near the bottom. Sometimes in very shallow water with deep mud below the surface a bird falling from a great height dead, or nearly so, may go out of sight in the mud and stay there. I have seen such a case.

An inquiry regarding the disappearance of wounded water-fowl was undertaken in 1921, and resulted in definite state-

ments from many observers. Mr. W. B. Mershon, Saginaw, Michigan (author of "The Passenger Pigeon"), says: "Frequently Canvasbacks have to be gotten up from below the surface dead;" but he believes this is due to weed entanglement. Mr. J. K. Jensen, Santa Fé, New Mexico, asserts that he has never seen a duck when wounded cling to the bottom until death, but he has known a wounded duck to die entangled in weeds at the bottom of a water hole in a peat bog. Dr. Arthur A. Allen says that a wounded Florida Gallinule dived and was caught in the pond-weeds so that it never came up.



Female.

Male.

RUDDY DUCK (*Erismatura jamaicensis*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

A diving Duck which when wounded sometimes goes to the bottom and stays there.

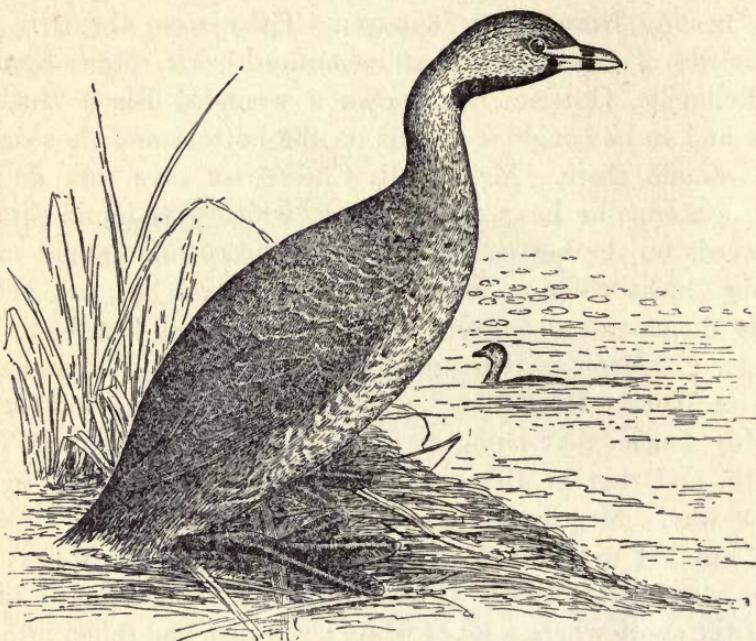
It was not, however, holding on by its bill. Mr. Edwin C. Kent of New York City, notes that when he was duck-shooting on the Hudson River, where flats were overgrown with eelgrass, it was a common occurrence for a wounded diving duck—Canvasback, Red-head, Scaup or Golden-eye—to dive and vanish. He says "two or three times when poking about with an oar I have brought up a bird dead." He believes that the birds became entangled in the grass and were too weak to free themselves. Mr. A. W. Schorges, Madison, Wisconsin, relates a similar occurrence with a Canvasback.

Mr. Ralph Hubbard, Boulder, Colorado, says that when he was trapping Black Ducks and Mallards on Lake Cayuga, New York, in connection with some experiments carried on in 1917

by Dr. Arthur A. Allen of Cornell University, one female Canvasback and one male Scaup were observed to poke their heads through wire netting under water and drown in this position at a depth of 2 feet or more. When taken out they did not seem to be definitely caught in any way. He does not believe that the birds voluntarily remained under water until death, but that this happened because of fatigue and fright, or, what is more likely, weakness due to starvation, as the lake was heavily frozen over in parts. These were the only two casualties of this nature that he noticed. Mr. Mark Sprague of Belleville, Ontario, has known a wounded Black Duck to dive and to be caught in weeds on the bottom and thus drown and remain there. Mr. M. R. Cheeseman says that on several occasions he has wounded ducks which were found clinging to weeds on the bottom; also he has chased and caught many young ducks clinging to weeds under water, but not one of these ducks was dead when taken. Mr. John Burnham, San Diego, California, writes me that at Heron Lake, Minnesota, and at Warner Hot Springs, San Diego, he has taken wounded Ruddy Ducks that clung to some object on the bottom until death, and that at Heron Lake he took a Canvasback in the same way. Mr. Kenneth C. Gurney reports that in 1904 he was hunting with Mr. G. L. Stevenson of Norway, Maine, and they wounded a Black Duck which when approached dived near the shore where a lot of white birch tops had fallen into the water. Mr. Stevenson from the bow of the canoe saw the bird with its head thrust in among the branches, but apparently it was not holding on by the bill. It was about  $2\frac{1}{2}$  feet under water. The bird finally came to the surface alive. Mr. Ludlow Griscom says that he has twice seen wounded Pintails and Green-winged Teals cling to the bottom, but that they finally let go and did not drown. In each case the water was quite shallow.

Dr. Thomas S. Roberts, Director, Zoölogical Museum, University of Minnesota, says that three times he has known birds to cling to some object on the bottom — once a male Mallard, once a Red-head, and once a Coot or Mud-hen. All these cases were in the vicinity of Minneapolis. He pulled all of the birds from their grip on lily leaf-stems or grass at the bottom. The

Coot was the deepest, at 2 feet from the surface. Dr. Roberts says that these birds were not quite dead when taken. Mr. David H. Scott, Iowa City, Iowa, says that he once saw a wounded Merganser drop very close to him in the rushes, and that he and his friend went after the bird in a boat when it dived. On coming to the place where it was last seen, it was finally found clinging to a weed at the bottom. Mr. Robert O.



Adult in summer.

PIED-BILLED GREBE (*Podilymbus podiceps*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

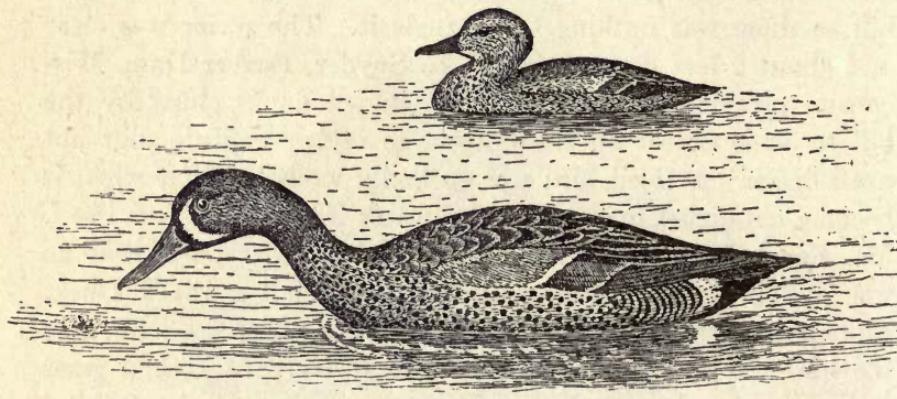
This species, when wounded, sometimes goes under water and stays there to die, either by holding on to vegetation or by pushing under it.

Morris, Springfield, Massachusetts, reports that he has seen a wounded Wood Duck clinging to weeds at the bottom of water two or three feet in depth. His dog finally brought in the bird. Mr. Albert J. B. Kirn, Solomon, Kansas, says that he has known a Pied-billed Grebe to cling with its feet to weeds under water when wounded and pursued. Mr. Willard E. Treat, Silver Lane, Connecticut, reports that he has found a Blue-winged Teal dead in a marsh with one foot clinging to a stalk of wild oats, which, however, was broken off and lying beside

the bird. He also says that he has known unwounded ducks and even a Canada Goose to become entangled in vegetation under water and drown there. Mr. Roy Latham says that wounded Black Ducks have been seen to dive and hold themselves down by grass stems until nearly dead. Others have reported to him that ducks have remained thus under water until death ensued. But he has not seen this. Mr. William A. Jeffries of Boston writes me that he knew of one case where a wounded Blue-winged Teal went to the bottom and stayed there, apparently it had taken hold. Both he and his guide observed the bird, head downward and body vertical, in short weeds or grass, and decided that it had caught hold with its bill as there was nothing to entangle it. The water was clear and about 2 feet deep. Mr. W. E. Snyder, Beaver Dam, Wisconsin, reports two cases where wounded ducks clung by the bill to some object on the bottom to escape capture, but not until death. A third bird was so badly wounded that when it became entangled in weeds under water it could not free itself. Mr. Frank W. Benson, Salem, Massachusetts, reports that he was gunning with George Patterson who shot a Black Duck, which disappeared in about a foot of water. After a long time the bird was found dead in some short eelgrass. It had grass in its mouth. Mr. G. Dallas Hanna says that at the Pribilof Islands, Alaska, he has seen both Harlequin ducks and Old-squaws dive when wounded, and never reappear. In only one case was he able to find the bird. This was a Harlequin which was found dead clinging with its bill to kelp near the bottom in water about 8 feet deep. Mr. John L. Cole, Nevada, Iowa, avers that he has known of several cases where ducks dived when wounded, clung until death, and released their hold shortly afterward. Dr. Malcolm F. Rogers, Milwaukee, Wisconsin, reports two cases in Oconomowoc Lake, Wisconsin: a Golden-eye in 1918 and a Scaup in 1920. These birds were wounded, dived and did not come up. They were found in about 5 feet of water, where they were seen clinging by the bill to weeds on the bottom. When hit with a paddle they floated to the surface, one dead and the other dying. Mr. R. Bruce Horsfall, Portland, Oregon, says that he has known a Mallard to cling to the bottom until death. This was in the Mississippi

River near Clinton, Iowa. When hunting with his brother several were lost in this way, also a Ruddy Duck. The Mallard was dislodged from its hold by Mr. Horsfall's brother, who used an oar for the purpose. The water was about 5 feet deep. The brother was acquainted with the trick and knew just what to expect and how to get the bird, as he was an experienced gunner. The bird was dead when it came to the surface, but Mr. Horsfall is not positive that it was not entangled in the grasses at the bottom.

Mr. Blair Coursen, 1177 East 55th Street, Chicago, records that a wounded Green-winged Teal dived when it hit the water



Male.

Female.

BLUE-WINGED TEAL (*Querquedula discors*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

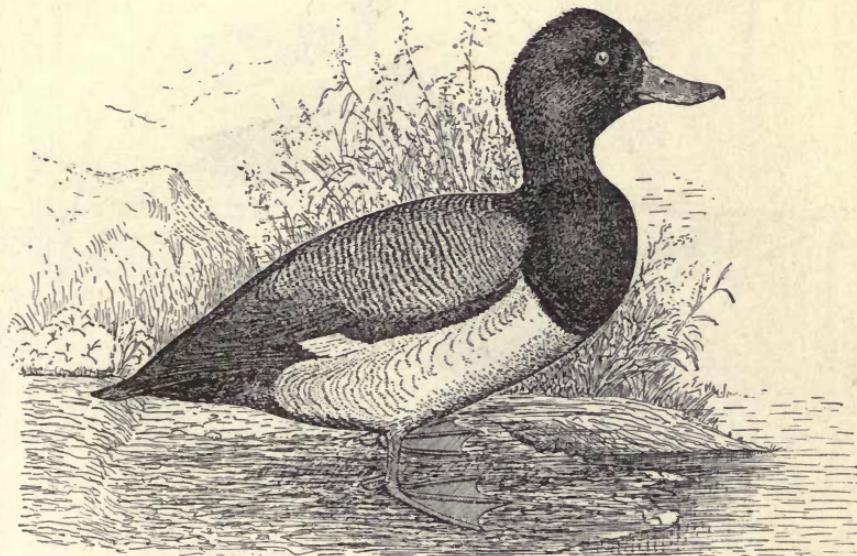
This duck, when wounded, sometimes hides under water by clinging to vegetation.

and was later found dead grasping grass tufts in its bill in about 2 feet of water. Mr. A. M. Brooking, Inland, Nebraska, says that he found a dead Blue-winged Teal clinging to reeds, and on being further questioned writes as follows:—

I can give you one specific instance of this in October, 1918. I was hunting in a lagoon. I shot a duck and it fell in an isolated bunch of rushes. I did not go to get it at once, but waited perhaps ten minutes. When I went to get the bird, it was not in sight. Upon search I found it below water grasping the base of a rush with both feet. Its body was in an upright position with its head stretched up, but its bill was several inches under water. When I dislodged it, it came to the top of the water. On one or two occasions I have found them with the bill sticking out of the water enough to get air, and on being dislodged they would endeavor to swim away.

Mr. Brooking's experience indicates how ducks and grebes are able to conceal themselves among water plants and maintain their position motionless with the bill just above the surface for breathing purposes. Major Allan Brooks, Okanagan Landing, British Columbia, relates experiences that seem to indicate that ducklings cling to the bottom with their feet:—

Young ducks (downies) can repose on the bottom without any effort. I don't know if adults can, but I have several times seen Mallards a few days old dive and sit, not lie, on the bottom in a foot of water or more. Once this happened on inundated pasture, and I could see



Male.

SCAUP (*Marila marila*).

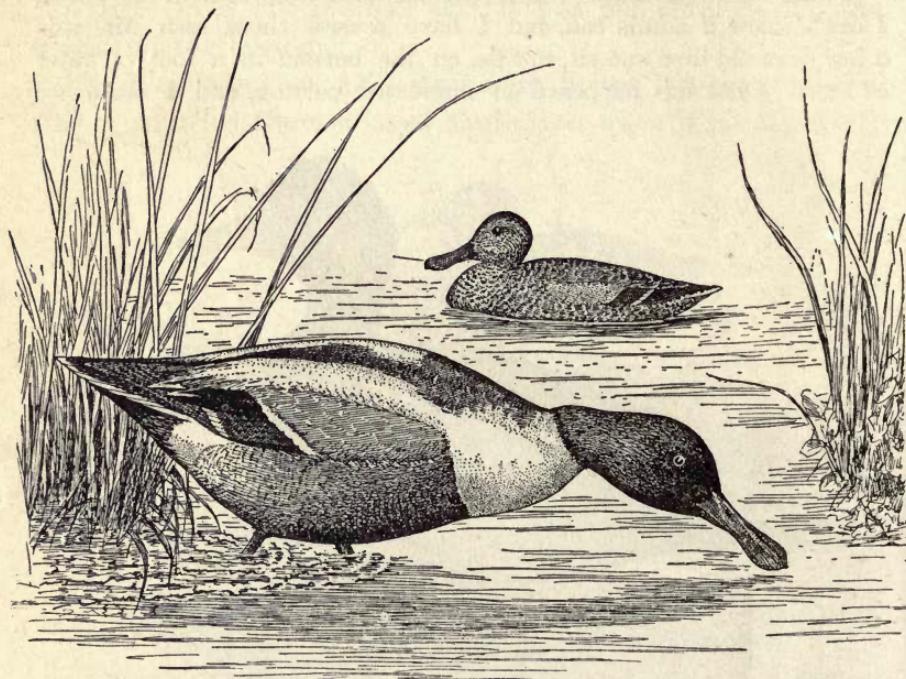
(From "Game Birds, Wild-Fowl and Shore Birds.")

Another bird which, when wounded, sometimes dives, clings and dies under water.

the little chaps sitting on the close-cropped turf with their eyes open in perfectly natural attitudes. When I waded in and picked one up it swam away on being liberated and did not attempt to hide or dive again.

Mr. Paul J. Fair of the United States Forestry service, San Francisco, California, found a dead Shoveller apparently clinging with its feet to weeds beneath the surface, but he is not positive that the feet might not have been entangled in some way. Mr. H. B. Steele, Jr., of Chicago tells of a Loon that was

shot and badly wounded at Plum Lake, Wisconsin, in the summer of 1917. It dived and stayed under water for several minutes, when its dead body rose to the surface. He says that it is "entirely certain" that it had not been entangled in anything at the bottom. It rose well away from the lily pads in which it might otherwise have been held down. Mr. Norman A. Wood of the Museum, University of Michigan, tells of a



Male.

Female.

SHOVELLER (*Spatula clypeata*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

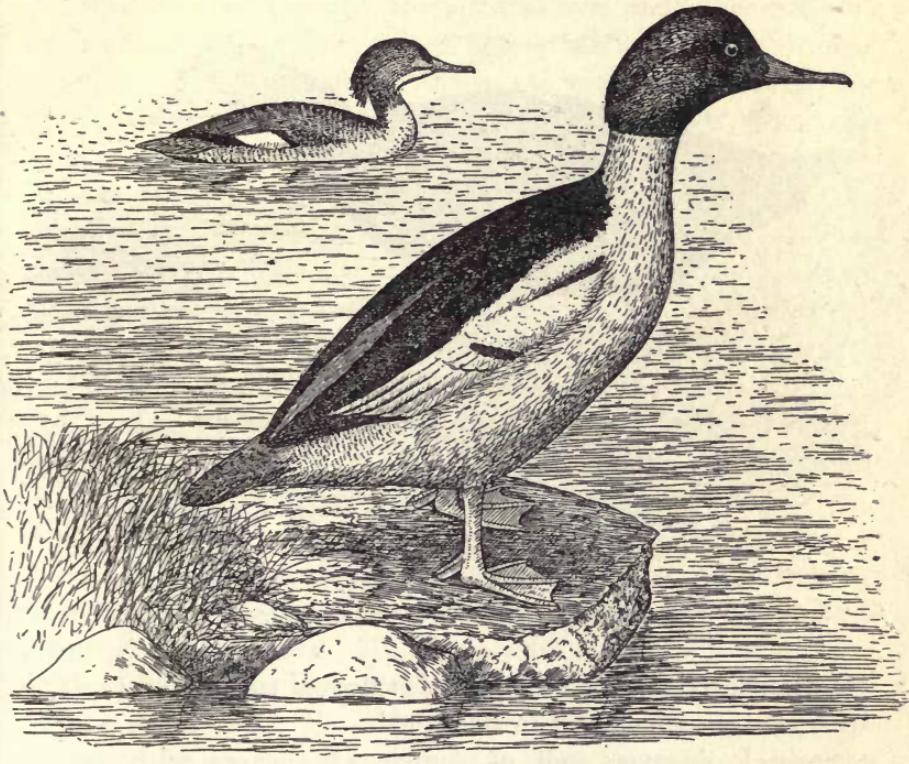
Another bird that, when wounded, sometimes secretes itself under water.

Red-head shot October 11, 1906, at Portage Lake, Michigan. Mr. Wood says that he was in the boat when the bird was shot on the wing. It fell, went under and did not come up. He looked for it and at last found it holding on to some weeds under water, dead. He had the same experience in October, 1920, at the same lake, but the bird was a Coot or Mud-hen. The water was only about a foot above the weeds, and the bird was dead. Mr. Harry M. Harrison, Camden, New Jersey, says that in April, 1916, he wounded an American Merganser

on the Choptank River, near Cambridge, Dorchester County, Maryland. It clung to some weeds at the bottom and was dislodged with an oar. It was not quite dead, but expired within a minute or two.

Mr. Wilfrid Wheeler, Concord, Massachusetts, former Massachusetts Commissioner of Agriculture, writes me as follows:—

I shot a Black Duck over a marshy pond. It fell in front of me, disappeared under water and did not come up. I waded in, and felt the bird



Female.

Male.

MERGANSER (*Mergus americanus*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

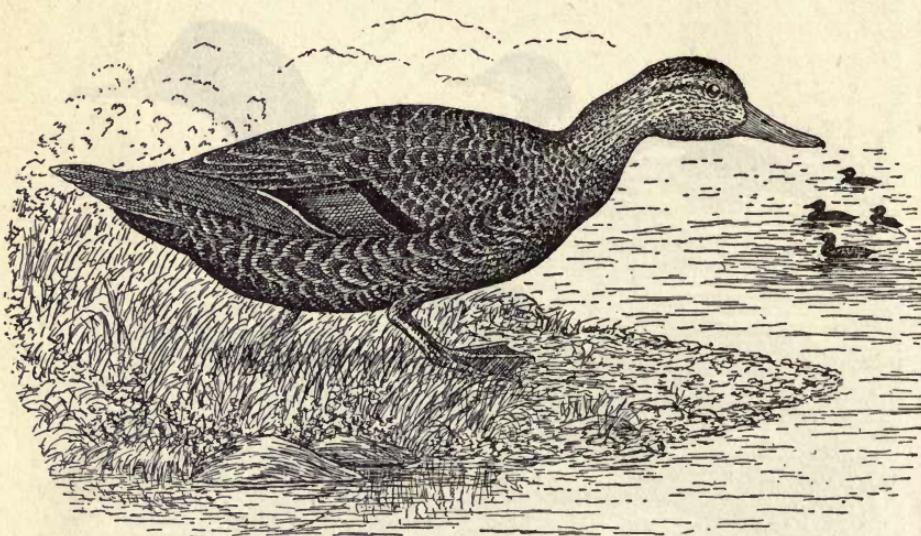
The Merganser, a "saw-bill duck," when wounded sometimes clings to reeds or other vegetation under water and dies there.

at the bottom where the water was perhaps 20 inches deep. I pulled it up dead and found its bill full of the weeds which grow in the pond. It was possibly fifteen minutes after I shot the duck before I got it.

Mr. Frank M. Woodruff, curator at the Chicago Academy of Arts and Sciences, writes that while wading in a marsh at

Pelican Rapids, Minnesota, he found a Ring-necked Duck dead which had grasped a weed and died holding on to it under water.

Mr. Everett H. Hiscox, Jewett City, Connecticut, writes that he was in a boat with two other hunters on Tadpole Pond near that town, when one of them shot a Black Duck which dived and failed to come up. They paddled to the spot. The duck could be plainly seen clinging to the bottom in 3 feet of water.



BLACK DUCK (*Anas rubripes tristis*).

(From "Game Birds, Wild-Fowl and Shore Birds.")

Wounded black ducks have been found clinging to under-water vegetation.

He disengaged it with an oar, and it floated to the surface dead, with the lily stems still in its mouth.

Several observers tell of similar experiences with grebes. But their evidence seems to indicate that these birds might have been entangled by aquatic vegetation, as they could be seen among vegetation on the bottom and remained there dead.

Mr. Charles B. Morss, Bradford, Massachusetts, writes me that, within the past ten years, he has known four Black Ducks and two Green-winged Teals to cling when wounded to objects on the bottom until death. He makes this definite by referring to his notes. The observations were made at a pond in Essex County, Massachusetts, and at Currituck Sound and Pamlico Sound, North Carolina. He says that he cannot decide whether

this is done purposely to elude capture, or whether the bird seizes on the vegetation with a clamp of agony, and then holds fast till death. Mr. George E. Burbank, Sandwich, Massachusetts, writes that he and his brother were accustomed to go gunning at Sandwich, on the shore at Town Neck, where there are large clusters of rocks extending out for some distance under water which are covered with barnacles, mussels and other small shellfish, together with various kinds of food suitable for aquatic birds. This was a great feeding ground for Old-Squaws, Red-breasted Mergansers, Surf and other Scoters, loons and grebes. The gunners hiding behind the beach-ridge watched the diving birds. When all were under water, the watchers ran down to the water's edge, and fired when the birds came to the surface. Many of these birds when wounded dived and never came up. The gunners were on the beach. There was no opportunity there for the wounded birds to hide, and they fled to such protection as was offered by the kelp and rockweed beneath the surface. Generally at this point the water is very clear, and Mr. Burbank writes that he has frequently seen the birds dead clinging among the kelp and rockweed, their bills closed about the stems of the kelp, which kept them from rising. If dislodged they came to the surface where they floated like any dead bird. Mr. Howard W. Eaton, Wolf, Wyoming, writes that at Conneaut Lake he has seen a Ruddy Duck in one instance and a Scaup in another cling to reeds under water until dead. After their death he pushed them free with an oar. Mr. Stanley C. Jewett tells of a Red-breasted Merganser shot at Netarts Bay, Oregon, which dived and never came to the surface. Three hours later, after the tide had ebbed, it was found dead, with its bill clamped to some plant. He did not at the time make note of the kind of vegetation to which the bird had held.

Mr. Walter H. Miller, La Porte, Indiana, writes as follows:—

I have had considerable experience hunting ducks, and have often pried Bluebills loose from the bottom with the use of an oar; sometimes they were dead and sometimes still alive. They always cling to the weeds with their bills. I have on several occasions taken them off of the weeds in shallow water with my hands.

That this habit is not peculiar to American waterfowl is proved by a report of Dr. Theodore G. Ahrens, Berlin, Germany, who says that George E. F. Schulz saw in 1920 an *Anser cinereus* (Gray Lag Goose) in Sweden, south of Stockholm, "dive when wounded and then cling fast under water until dead." Other reports might be cited, but lack of space forbids.

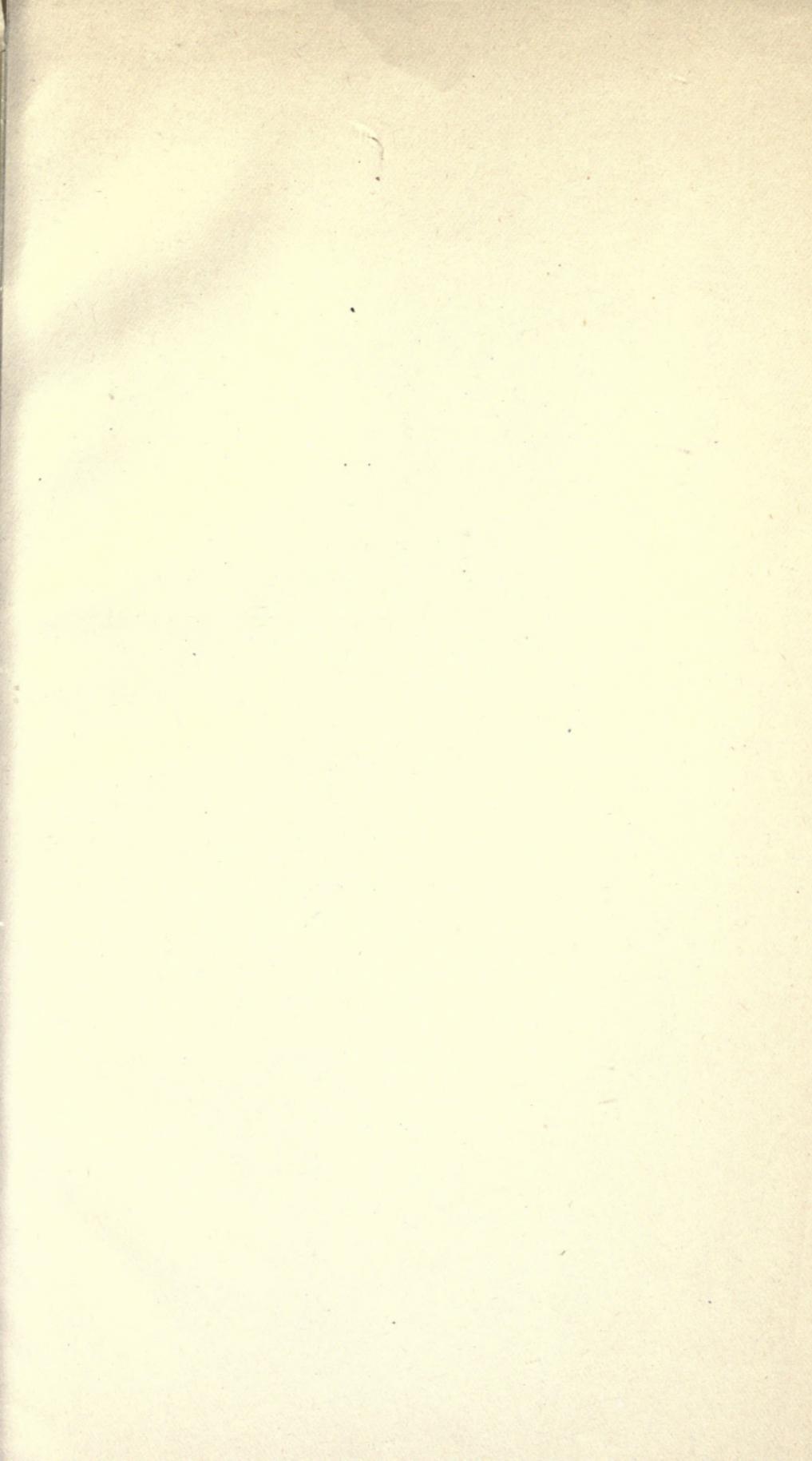
From the above and much similar evidence now in my files we may draw the following conclusions: (1) wounded waterfowl, weakened and perhaps dying, often seek safety below the surface in under-water vegetation; (2) in some cases they are entangled in this vegetation and die there; (3) in other cases they grasp aquatic plants with the bill or the feet and hold on till death; (4) sometimes they remain attached after death; (5) there is no conclusive evidence that they either purposely or unwittingly drown themselves; nor is there any evidence that they do not do so. It is quite possible that a bird in its death agonies, gasping for breath under water and perhaps unconscious, might inhale water and drown, but we have no convincing evidence of this as, so far as I know, no one has examined a bird in such case to see if its lungs contained water. Granted that at such a time water might be inhaled, it might so reduce the buoyancy of the bird that it would remain under water after death, even if very slightly attached.

It seems unlikely that a dead bird would hold its position by either bill or feet after death, if it had not reduced its buoyancy by inhaling water. After death the muscles relax and the grip of the bill naturally would relax also, but if the bill is lamellated, toothed or serrated, as in many water birds, and closed tightly in the death grip upon succulent vegetation, thereby penetrating the tissues of the plant with its sharp edges or point, it might retain its hold even after death, particularly if the buoyancy of the bird had been reduced by the inhalation of water. I am told by medical men that the "*rigor mortis*," or rigidity of death, sets in very quickly under some conditions. If this should occur quickly, the grip might be maintained for some time after death, or until the muscles relaxed again.

The entanglement of birds in under-water vegetation may be accounted for in the following manner: The tendency of birds

when wounded and pursued is to hide. When there is no hiding place on the surface, divers naturally seek concealment under water. In their panic they may dive into the clinging vegetation near the bottom. The natural tendency of birds whenever they find their progress obstructed or their heads or necks enmeshed, is to push forward through any aperture that may present itself, rather than to draw back. In withdrawing they go "against the grain" of the feathers, and their wings or feet are likely to become entangled, so they press strongly forward. The poacher takes advantage of this habit and leaves apertures in a hedge in which he puts snares for game birds. In pressing forward to push through the snares they are strangled. Thus also the diving bird, seeking concealment for the time being, may become enmeshed or entangled under clinging aquatic vegetation, and, being weakened by loss of blood or perhaps dying from a gunshot wound, may be unable to work through the entanglement and reach the surface, and so drowns, the body remaining held fast where it lies. This may explain why the diving ducks at Ithaca did not withdraw their heads from the interstices of the wire netting, from which they might have escaped. They may have drowned there while trying to push through.

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